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UNITED STATES GEOLOGICAL SURVEY

Prepared in cooperation with the
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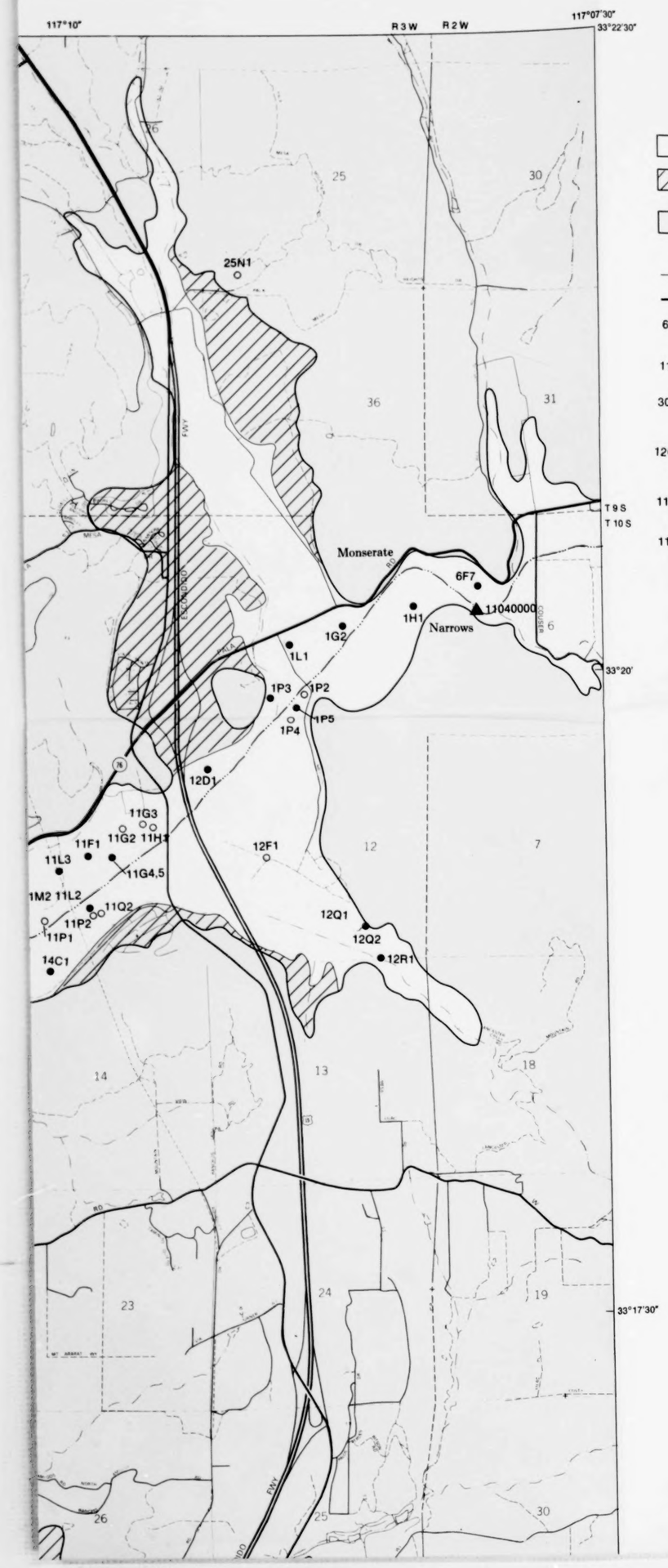

EXPLANATION

- ALLUVIUM
- COLLUVIUM AND WEATHERED CRYSTALLINE ROCKS– Generally covered by a thin layer of alluvium
- CRYSTALLINE ROCKS– Generally covered by a thin layer of alluvium and colluvium near stream channels
- CONTACT
- BOUNDARY OF GROUND-WATER BASIN
- 6F7 ● OPERATIONAL WELL AND NUMBER–Includes domestic and agricultural wells
- 11P1 ○ ABANDONED WELL AND NUMBER
- 30J4 ◎ U.S. GEOLOGICAL SURVEY OBSERVATION WELL AND NUMBER
- 12Q2 ● SPRING AND NUMBER
- 11040700 ▲ U.S. GEOLOGICAL SURVEY STREAM-GAGING STATION AND NUMBER– Solid symbol is active and open symbol is destroyed
- 11041000 ▲

WELL-NUMBERING SYSTEM

Wells are numbered according to their location in the rectangular system for subdivision of public land. For example, in well number 10S/3W-11L3, that part of the number preceding the slash indicates the township (T. 10 S.); the number and letter following the slash indicate the range (R. 3 W.); the number following the hyphen indicates the section (sec. 11); the letter following the section number (L) indicates the 40-acre subdivision of the section; and the final digit (3) is a serial number for wells in each 40-acre subdivision. Township and range are given along the margins of the maps so that wells are identified using only the section, 40-acre subdivision, and serial number for wells in the subdivision. All wells in this report are numbered from the San Bernardino base line and meridian.

D	C	B	A
E	F	G	H
M	L	K	J
N	P	Q	R

WELL LOCATIONS

The purpose of this report is to provide information on ground-water conditions in the Bonsall area of the San Luis Rey River valley, San Diego County, Calif. This report consists of five maps and was prepared by the U.S. Geological Survey as part of a larger cooperative study with the Rainbow Municipal Water District.

The Bonsall area (State hydrologic unit number Z-3.A2, California Department of Water Resources, 1964) contains part of the San Luis Rey River valley alluvial aquifer (basin 9-7, California Department of Water Resources, 1975). The study area extends from the stream gage at Monserate Narrows in the east to the destroyed stream gage at the narrows near Bonsall in the west. The total area extent of alluvial deposits is 4,300 acres. An additional 1,200 acres of colluvium and weathered crystalline rocks are exposed on slopes surrounding the alluvial deposits. The total drainage area between the stream gage at Monserate Narrows and the destroyed gage at the narrows near Bonsall is approximately 140 mi^2.

In November 1983, 84 wells and 1 spring were inventoried by U.S. Geological Survey personnel. Of these wells, 37 were operational and 47 were abandoned. Ten additional wells were drilled by the U.S. Geological Survey for this study.

REFERENCES

California Department of Water Resources, 1964, Map of location of hydrologic boundaries, San Diego drainage province.

_____ 1975, California's ground water: Bulletin 118, 135 p.

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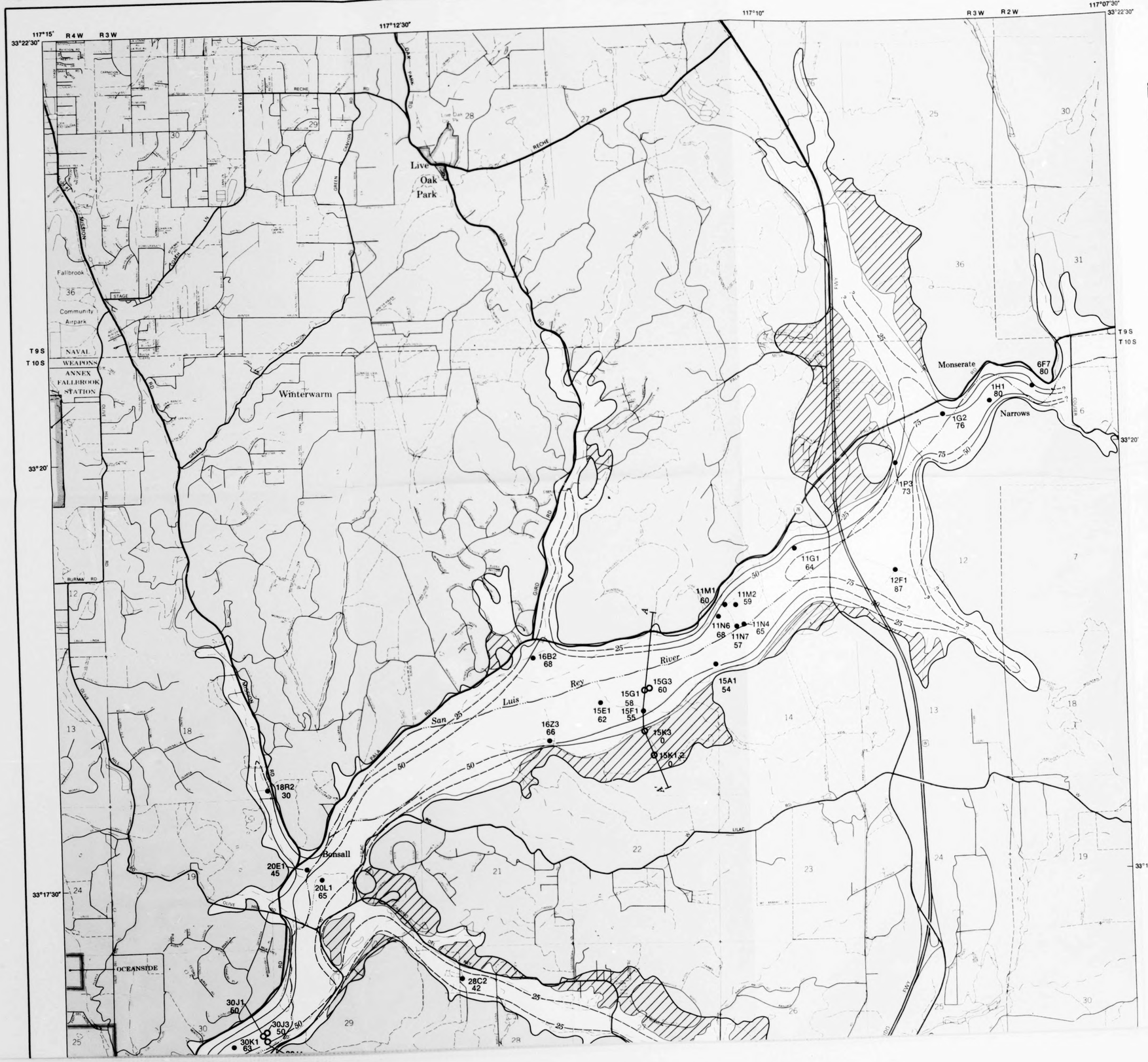
WATER-RESOURCES INVESTIGATIONS
REPORT 85-4112 (SHEET 2 of 5)



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- CONTACT
- BOUNDARY OF GROUND-WATER BASIN
- —25— LINE OF EQUAL THICKNESS OF ALLUVIUM–Interval 25 feet. Dashed where approximate. Queried where uncertain
- 1H1 / 80 ● WELL–Upper number is well number. Lower number is thickness of alluvium in feet
- 15G3 / 60 ○ U.S. GEOLOGICAL SURVEY OBSERVATION WELL–Upper number is well number. Lower number is thickness of alluvium in feet
- A — A' LINE OF GEOLOGIC SECTION
- CONTACT BETWEEN COLLUVIUM AND WEATHERED CRYSTALLINE ROCKS– Geologic cross section only

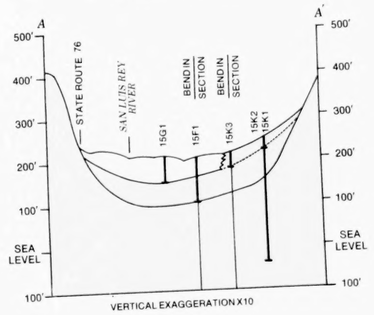
THICKNESS OF ALLUVIAL FILL

Alluvial fill in the Bonsall area is primarily a well-sorted fine sand with small amounts of silt and clay. Maximum thickness of alluvial fill exceeds 75 feet in the eastern part of the alluvial aquifer. Alluvial deposits thin to slightly more than 50 feet in the western part. The alluvial aquifer contains approximately 113,000 acre-feet of fill. If an average specific yield of 0.16 (Moreland, 1974) is applied, maximum ground-water storage is estimated at 18,000 acre-feet. In some areas, the alluvial aquifer is surrounded and underlain by colluvium and weathered crystalline rock (section A-A'). This material is water bearing and contributes additional ground-water storage capacity to the system. The unweathered crystalline rocks yield only small quantities of water from cracks and fissures; for the purposes of this report they are considered to be non-water bearing.

REFERENCES

Moreland, J. A., 1974, Hydrologic- and salt-balance investigations utilizing digital models, lower San Luis Rey River area, San Diego County, California: U.S. Geological Survey Water-Resources Investigations 27-74, 66 p.

GEOLOGIC SECTION



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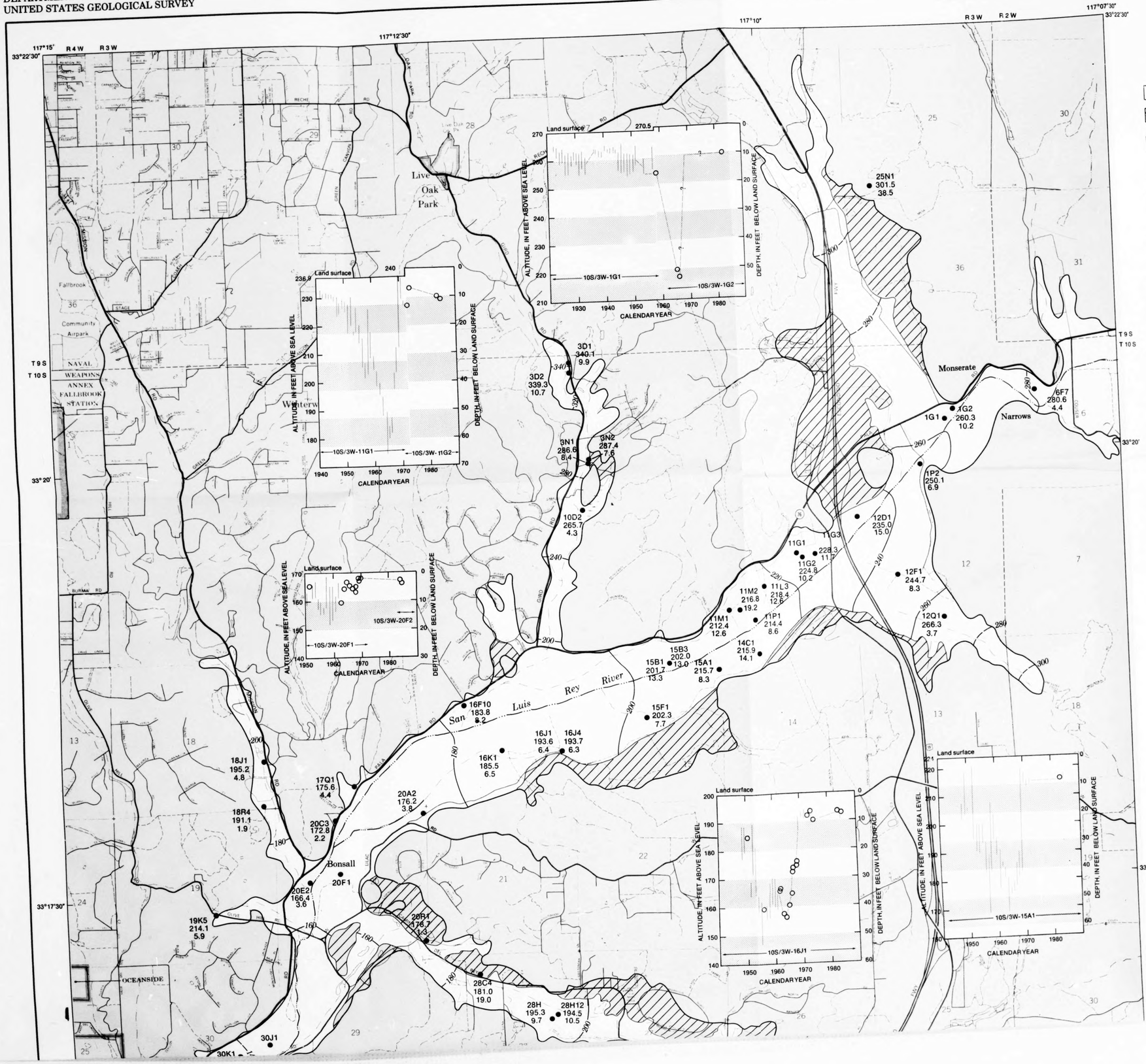

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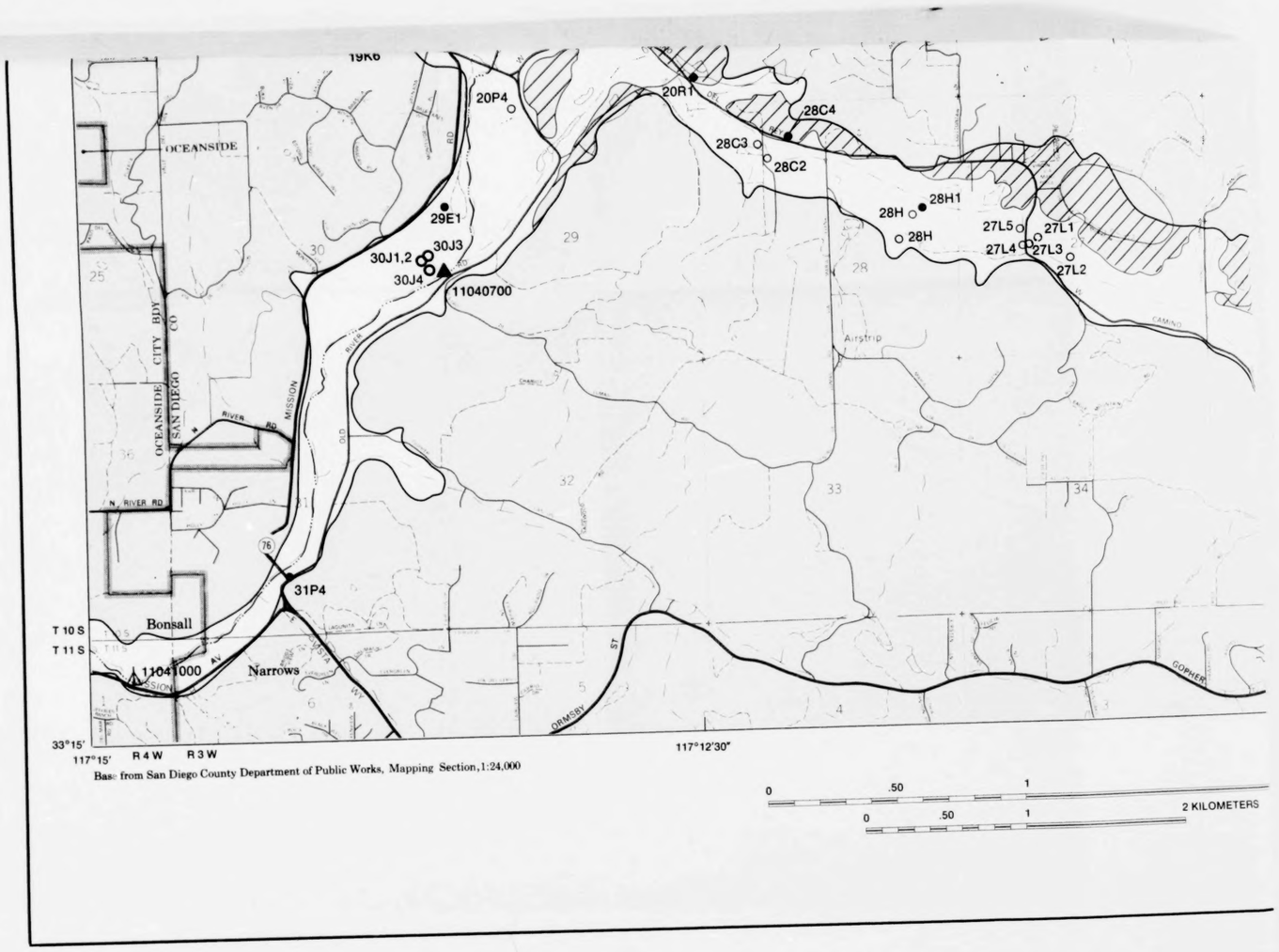
- CONTACT
- BOUNDARY OF GROUND-WATER BASIN
- --200– WATER-LEVEL CONTOUR– Shows altitude of water level , in feet above sea level. Contour interval variable. Dashed where approximate
- 6F7 ● 2806 4.4 WELL– Upper number is well number. Middle number is water level altitude, in feet above sea level. Lower number is depth below land surface, in feet
- ○ HYDROGRAPH– Vertical bar shows range of water-level altitude, in feet above sea level and depth, in feet below land surface. Circles represent individual measurement. Dashed where approximate, queried where uncertain

WATER-LEVEL CONTOURS, NOVEMBER 1983, AND HYDROGRAPHS OF SELECTED WELLS

Water levels measured in 38 wells during November 1983 ranged from 1.3 to 38.5 feet below land surface. Of 33 wells completed in the alluvial aquifer, 23 had water levels within 10 feet of land surface. Depth to water was greatest for wells outside the alluvial aquifer. Ground-water movement in the alluvial aquifer was from Monserate Narrows downgradient to the narrows near Bonsall, and the alluvial aquifer was discharging ground water to the San Luis Rey River.

Water-level hydrographs for selected wells in the alluvial aquifer show changes in ground-water levels with time. Depth to water exceeded 66 feet in well 10S/3W-11G1 on June 30, 1964, at that time, the well, which fully penetrated the alluvial aquifer, was dry. Depth to water in wells in the western part of the aquifer did not exceed 25 feet during the period of available record.



Base from San Diego County Department of Public Works, Mapping Section, 1:24,000

WELL LO

MAPS OF THE BONSALL AREA OF THE SAN LUIS RE
SHOWING GEOLOGY, HYDROLOG

JOHN A.

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Geology modified from Moyle, W.R., Jr., 1971, Water wells in the San Luis Rey River valley area, San Diego County, California: California Department of Water Resources Bulletin 91-18, 347 p.

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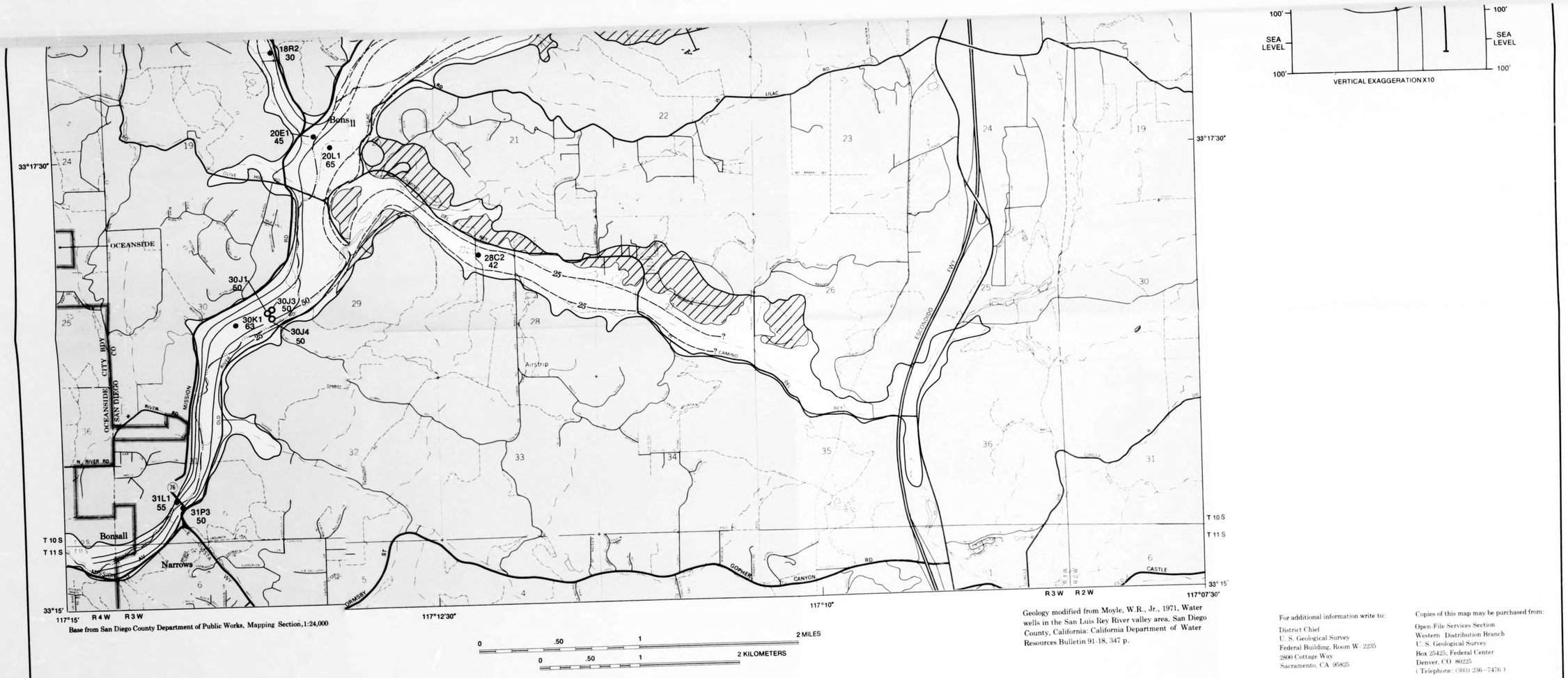
WELL LOCATIONS

AN LUIS REY RIVER VALLEY, SAN DIEGO COUNTY, CALIFORNIA
YDROLOGY, AND GROUND-WATER QUALITY

BY
JOHN A. IZBICKI

1985



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THICKNESS OF ALLUVIAL FILL

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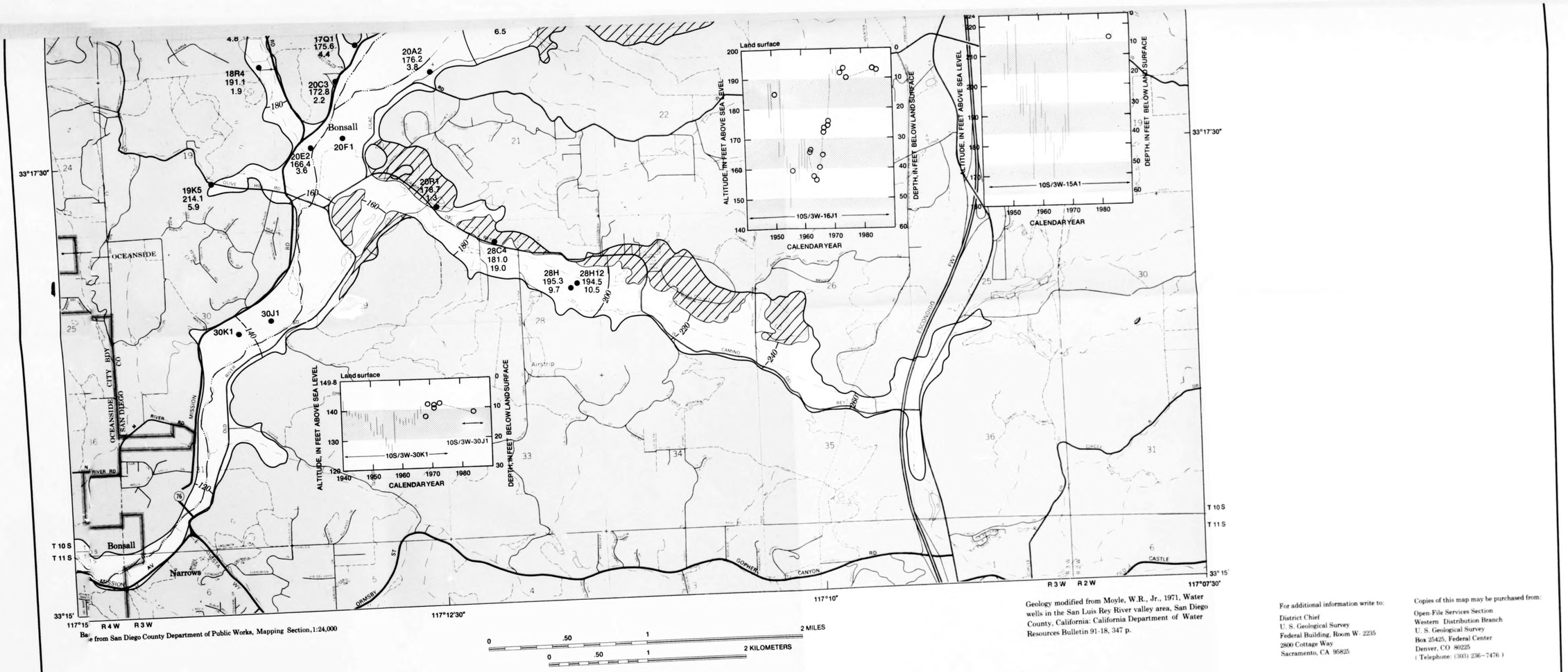

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WATER –LEVEL CONTOURS, NOVEMBER 1983, AND HYDROGRAPHS OF SELECTED WELLS

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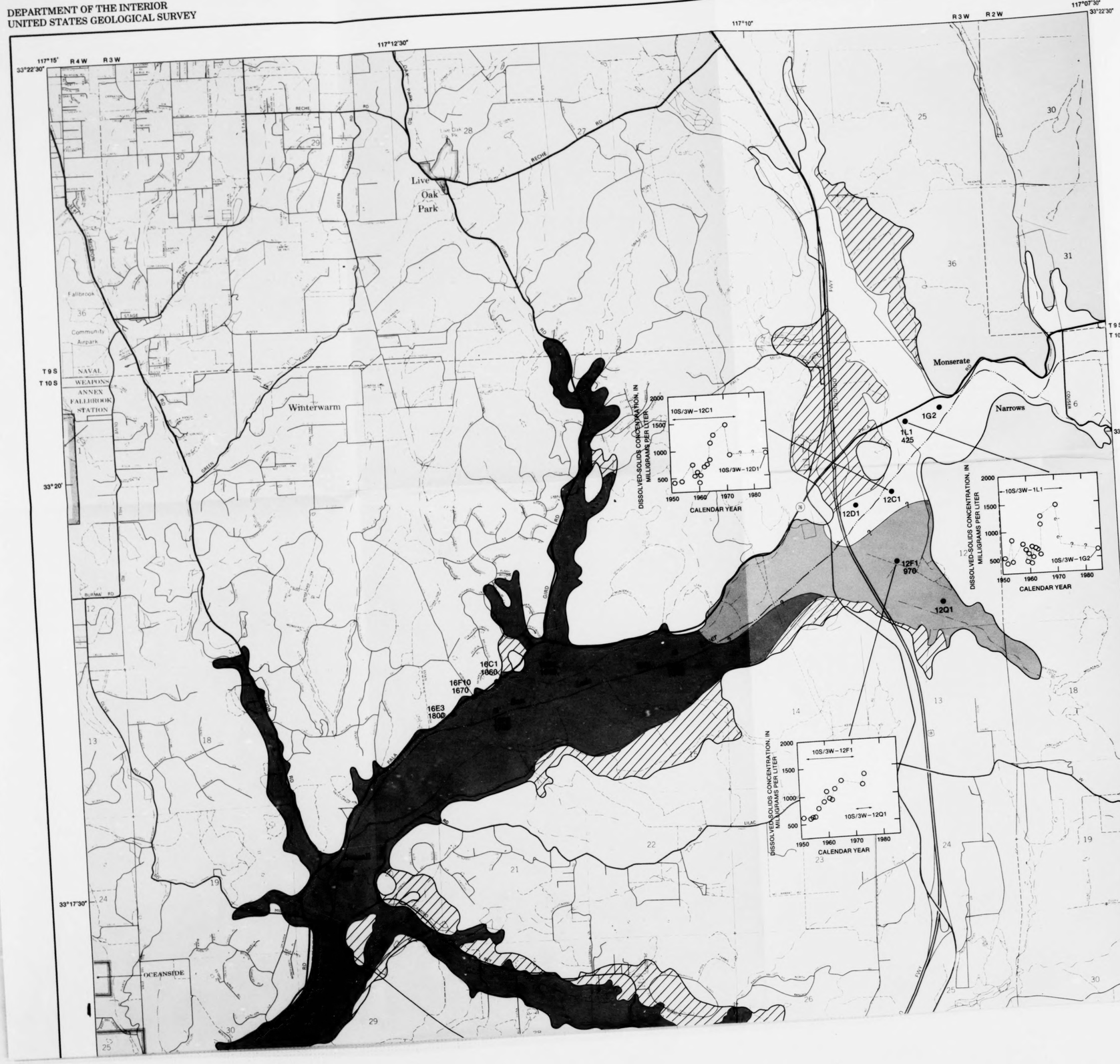

EXPLANATION

ALLUVIUM– Colors indicate range of dissolved-solids concentration, in milligrams per liter. Ranges based on miscellaneous dissolved-solids measurements between 1957 and 1963. Queried where uncertain

- Less than 500
- 500 to 1000
- More than 1000

COLLUVIUM AND WEATHERED CRYSTALLINE ROCKS– Generally covered by a thin layer of alluvium

CRYSTALLINE ROCKS– Generally covered by a thin layer of alluvium and colluvium near stream channels

CONTACT

BOUNDARY OF GROUND-WATER BASIN

12F1 970 ● WELL– Top number is well number. Bottom number is dissolved-solids concentration, in milligrams per liter, in spring 1960

○ GRAPH–Circles represent individual measurement. Dashed where approximate; queried where uncertain

GROUND-WATER QUALITY IN SPRING 1960 AND GRAPHS SHOWING CHANGES IN DISSOLVED SOLIDS CONCENTRATION OF WATER FROM SELECTED WELLS WITH TIME

Dissolved-solids concentrations of water from 15 wells sampled in 1960 ranged from 425 to 1,800 mg/L (milligrams per liter). All sampled wells yielding water with a dissolved-solids concentration less than 1,000 mg/L were in the eastern part of the aquifer. Ranges in dissolved-solids concentrations shown on the map are based on one or more chemical analyses of water samples collected between 1957 and 1963; the ranges are approximate and are intended for comparison with 1983 data.

Water-quality data from selected wells in the Bonsall alluvial aquifer show an increase in the dissolved-solids concentration of ground water between 1950 and the late 1960's. Dissolved-solids concentration of water from well 10S/3W-12C1 decreased in 1970; this may be due in part to recharge from the San Luis Rey River after floods of 1969. Data from nearby wells with similar perforated intervals were used to extend water-quality records from wells 10S/3W-1L1, 10S/3W-12C1, and 10S/3W-12F1.

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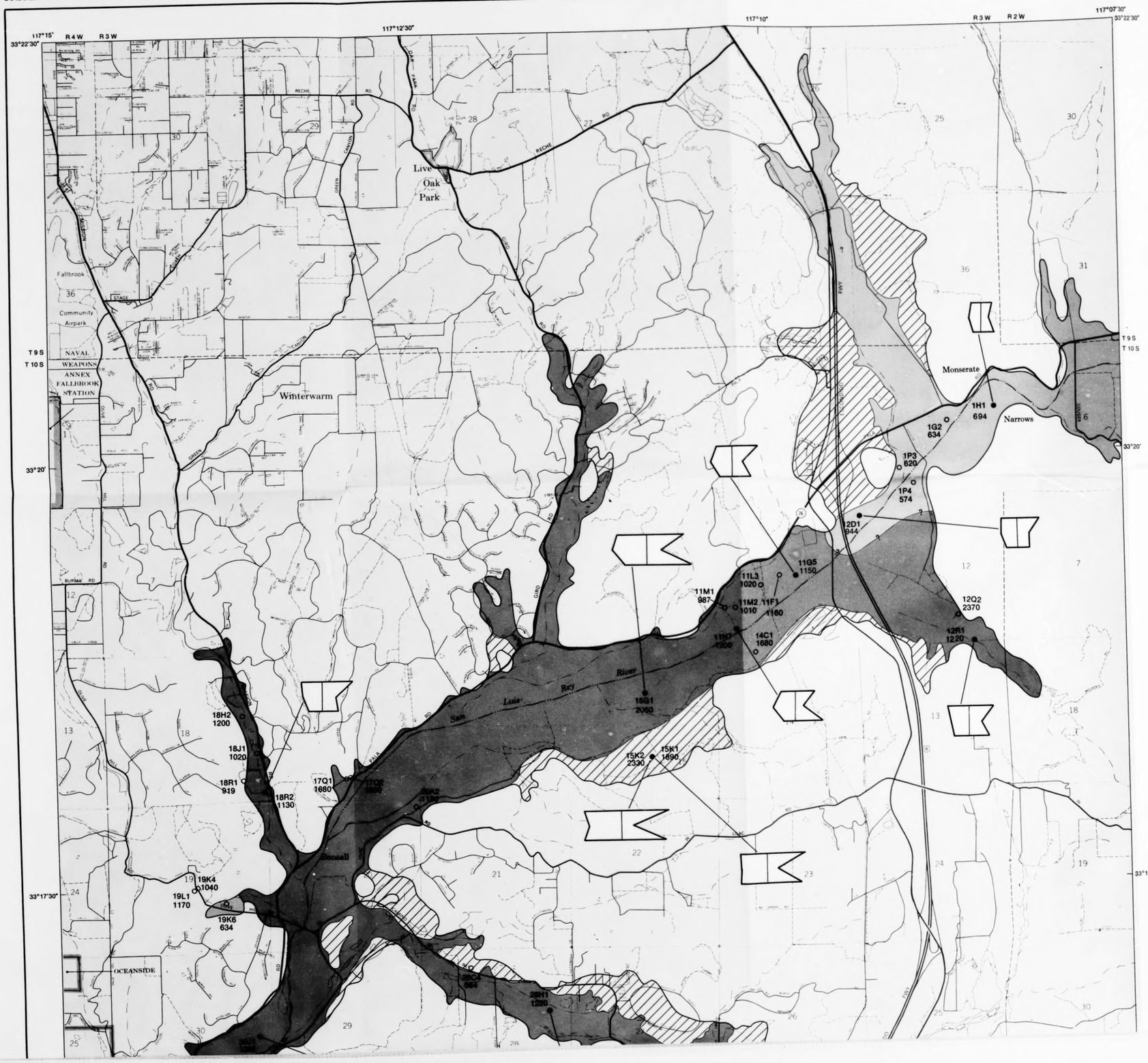

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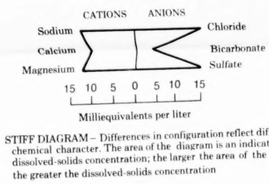
CONTACT

BOUNDARY OF GROUND – WATER BASIN

1H1 694 ● WELL – Upper number is well number. Lower number is dissolved-solids concentration, in milligrams per liter

1G2 634 ○ WELL – Upper number is well number. Lower number is dissolved-solids concentration, in milligrams per liter, estimated from specific conductance, in microsiemens per centimeter at 25 degrees Celsius

12Q2 2370 ○ SPRING – Upper number is spring number. Lower number is dissolved-solids concentration, in milligrams per liter estimated from specific conductance, in microsiemens per centimeter at 25 degrees Celsius



STIFF DIAGRAM – Differences in configuration reflect differences in chemical character. The area of the diagram is an indication of the dissolved-solids concentration; the larger the area of the diagram, the greater the dissolved-solids concentration

GROUND-WATER QUALITY IN SPRING 1984

Field measurements of specific conductance of water from 29 wells and 1 spring were made in autumn 1983 and spring 1984. Specific-conductance data were converted to dissolved-solids concentrations using the relation:

$$DS = 0.75SC - 153$$

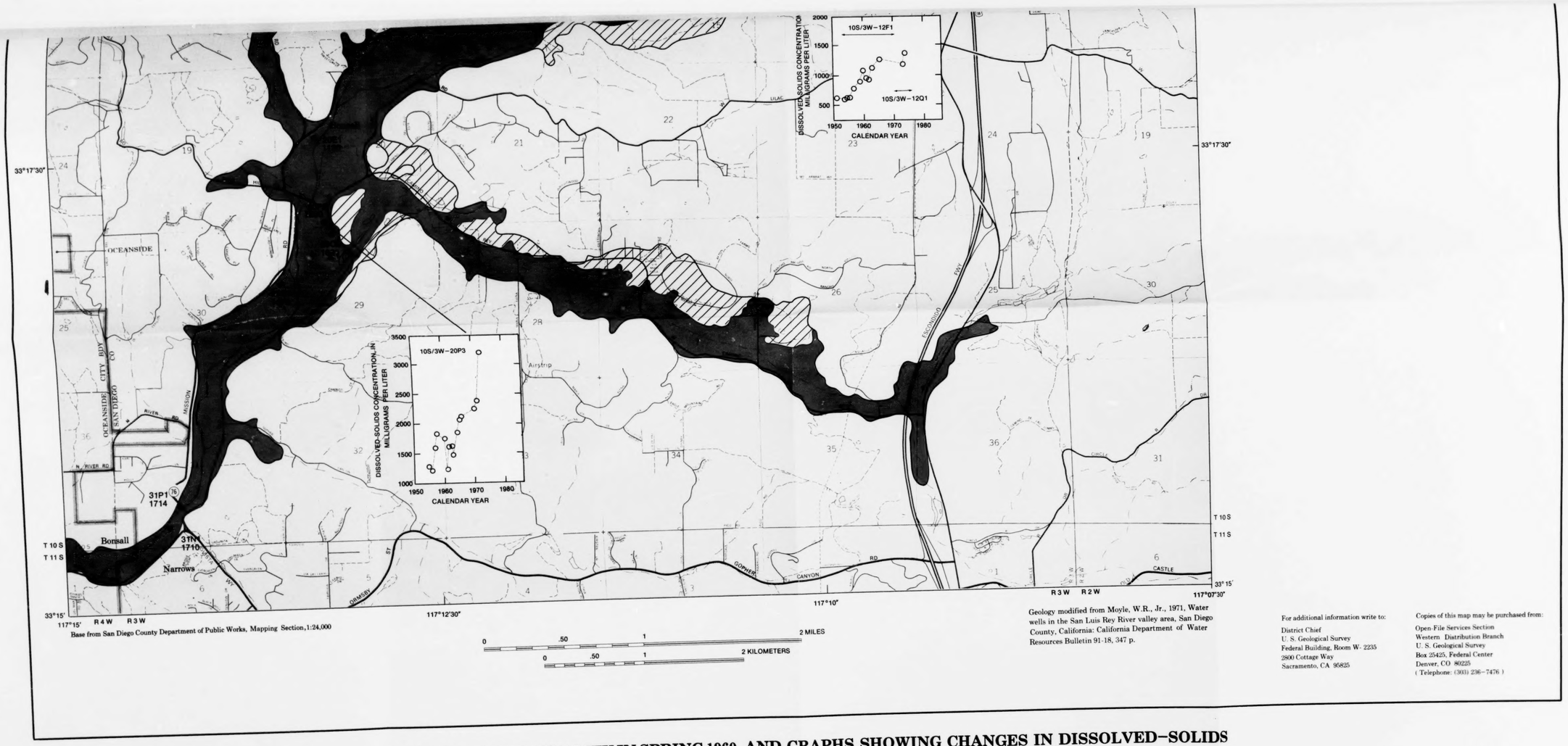
where

DS is dissolved-solids concentration, in milligrams per liter; and
SC is specific conductance, in microsiemens per centimeter at 25°C.

The relation was developed, with data collected by the U.S. Geological Survey in spring 1984, using linear regression. Eleven samples with dissolved-solids concentrations ranging from 694 to 2,330 mg/L were used in the analyses, and an R^2 of 0.98 was obtained. (R^2 is a statistic which describes the "goodness of fit" of data about a line. It may range from 0 for a very poor fit to 1 for a perfect fit). The data base included analyses from two wells outside the alluvial aquifer: well 10S/3W-15K1 is 60 feet deep and yields water from weathered crystalline rock; well 10S/3W-15K2 is 300 feet deep and yields water from two fractures in crystalline rock at 120 and 275 feet below land surface. The relation between dissolved-solids concentration and specific conductance is basin specific and care should be used when extrapolating to other areas.

Dissolved-solids concentrations (estimated and measured) of water from 30 sites in the Bonsall area ranged from 574 to 2,370 mg/L. Ground water with a dissolved-solids concentration less than 1,000 mg/L was generally restricted to the eastern part of the aquifer. However, three wells (10S/3W-18R1, 10S/3W-19K6, and 10S/3W-28C4) in the western part of the aquifer yielded water with dissolved-solids concentrations less than 1,000 mg/L. These wells were located in side canyons, and at least one well (10S/3W-28C4) was completed in colluvium and weathered crystalline rocks. Nine of eleven wells yielded water with sulfate concentrations that exceeded the EPA (U.S. Environmental Protection Agency) recommended limit of 250 mg/L. Nine of eleven wells yielded water with chloride concentrations that exceeded the EPA recommended limit of 250 mg/L. No wells yielded water that exceeded the EPA recommended limit of 10 mg/L nitrate as nitrogen.

The small diagrams to the side are stiff diagrams. Stiff diagrams graphically show relative magnitude of major dissolved ions in water, expressed in milliequivalents per liter. Concentrations in milligrams per liter are converted to milliequivalents per liter by dividing by the atomic weight and then multiplying by the ionic charge. When an analysis is expressed in



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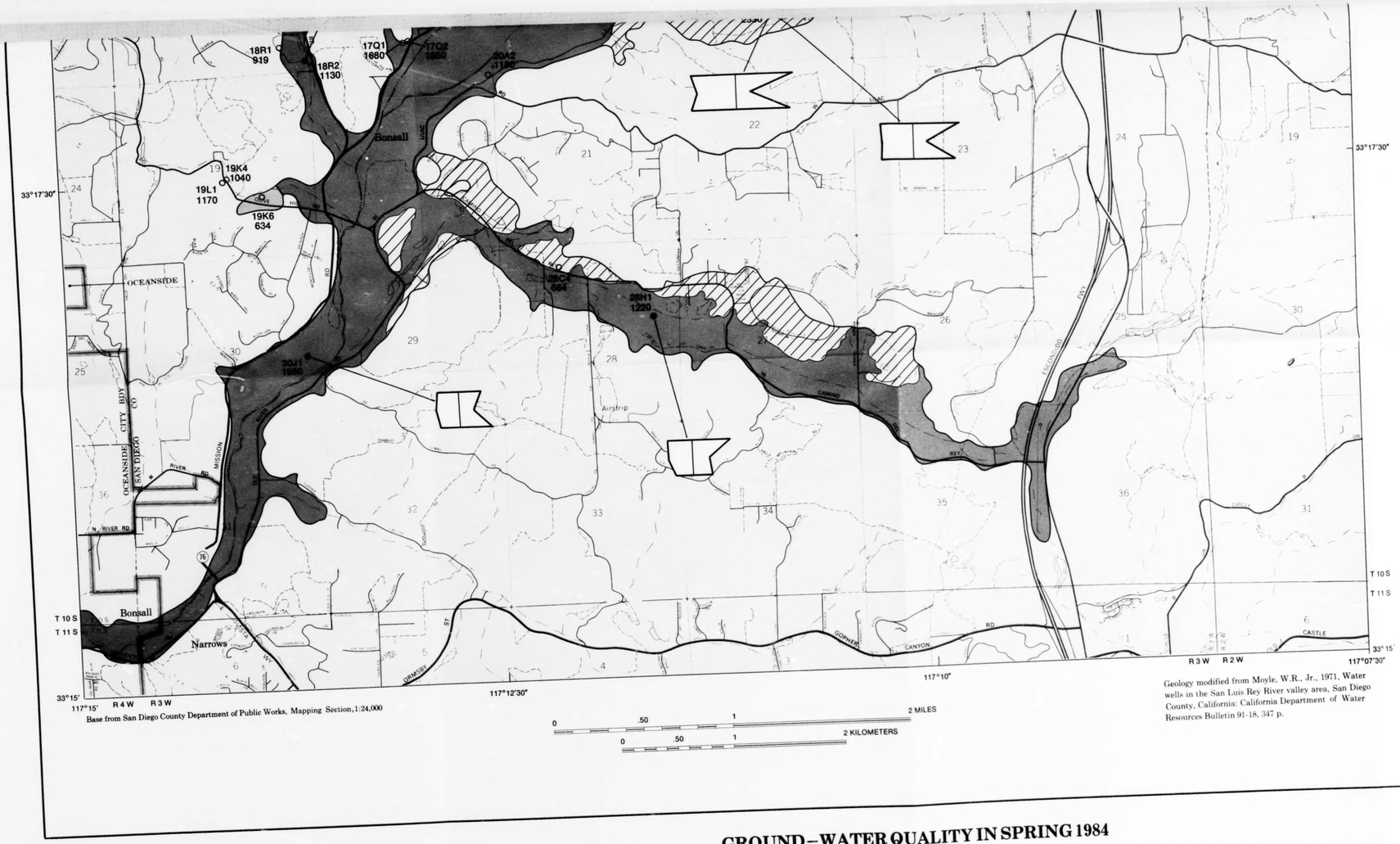

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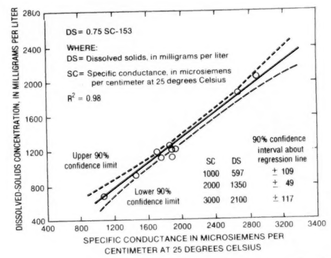

RELATION BETWEEN DISSOLVED-SOLIDS CONCENTRATION AND SPECIFIC CONDUCTANCE IN THE BONSALL AREA OF THE SAN LUIS REY RIVER VALLEY, SAN DIEGO COUNTY, CALIFORNIA

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